This is an amendment to Topical Broad Agency Announcement (BAA) for Embedded Instrumentation Test and Evaluation #043224. This amendment includes the Embedded Instrumentation briefing presented at the Bidders Conference held on 06 October 2004; final Questions and Answers from the Bidders Conference and the List of Conference Attendees.

Test and Evaluation/Science and Technology Program

Embedded Instrumentation "Technology Enabled T&E Process Transformation"


Presented by:

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Purpose of Briefing

- Introduce Director, Operational Test and Evaluation T&E/S&T Embedded Instrumentation Focus Area
- Provide a broad overview of the need and benefits of Embedded Instrumentation in the Acquisition Process and for the Warfighter
- EI Focus Area BAA for FY 05

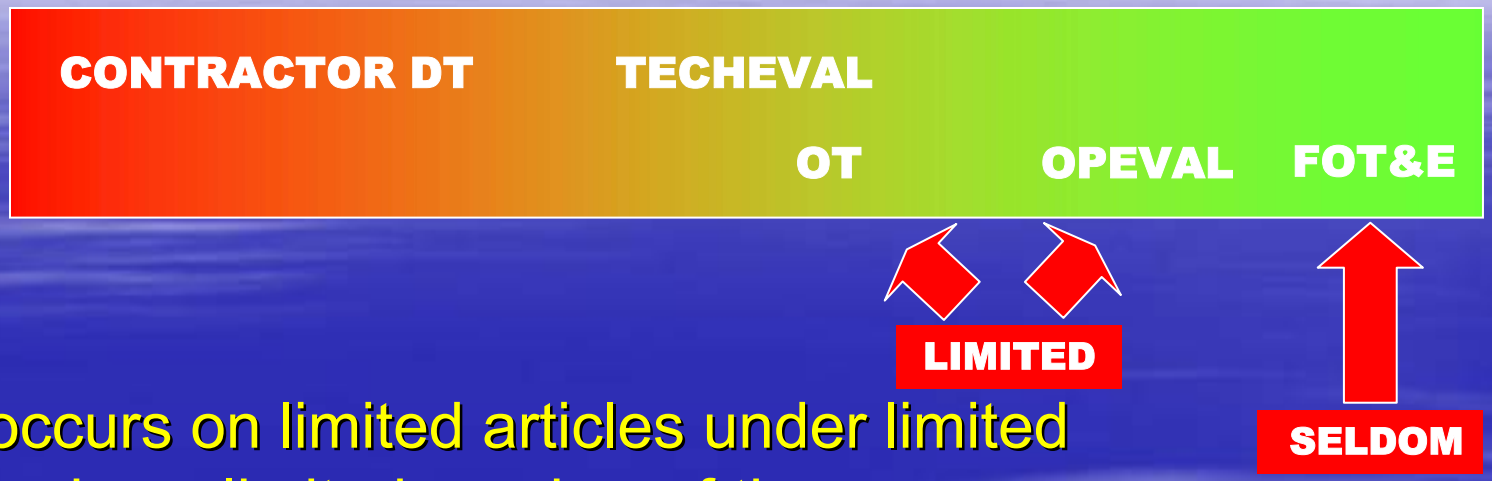
A History of Warfare

The fundamental military strategy has always been the massing of force with a focus on "attrition warfare"

Unmanned combat vehicles, precision guided munitions, and full situational awareness signify the advent of "effects-based warfare"

We have only just begun the "Technology Enabled Warfighting Transformation"

Current T&E Process



- OT occurs on limited articles under limited scenarios a limited number of times
- Many operational characteristics can only be ascertained over extended periods time and widely varying tactical scenarios
- Time, cost, and test resource availability are significant issues that impact effective OT

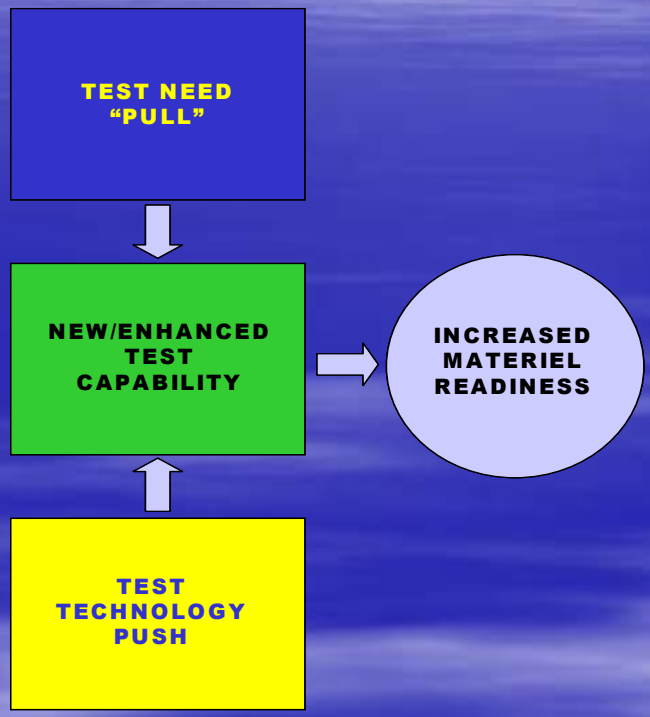
T&E is a cornerstone of acquisition

Test Capability Needs

- Hard test requirements & needs are difficult to establish because of acquisition program financial accountability
- While warfighting systems can be driven by "technology push"

  Advances in test technology seldom drive new test capability

- Test planning usually revolves around available test resources and capabilities



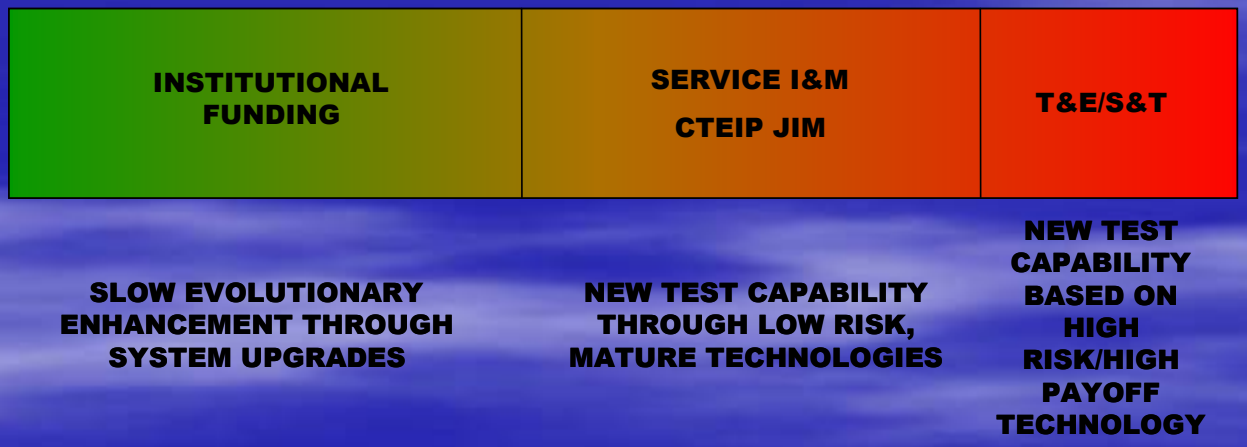
Test Capability Solutions

- There is always a need to balance risk with project executability
- Executability drives test capability solutions towards lower risk, more mature technologies

Without an infusion of new technology, test capabilities may not keep pace with the systems being tested

T&E/S&T Program

- A program of the Director, Operational Test and Evaluation office
- Balances the need for CTEIP JIM (and Service I&M) project executability with the need for new high risk/high payoff technology in support of T&E

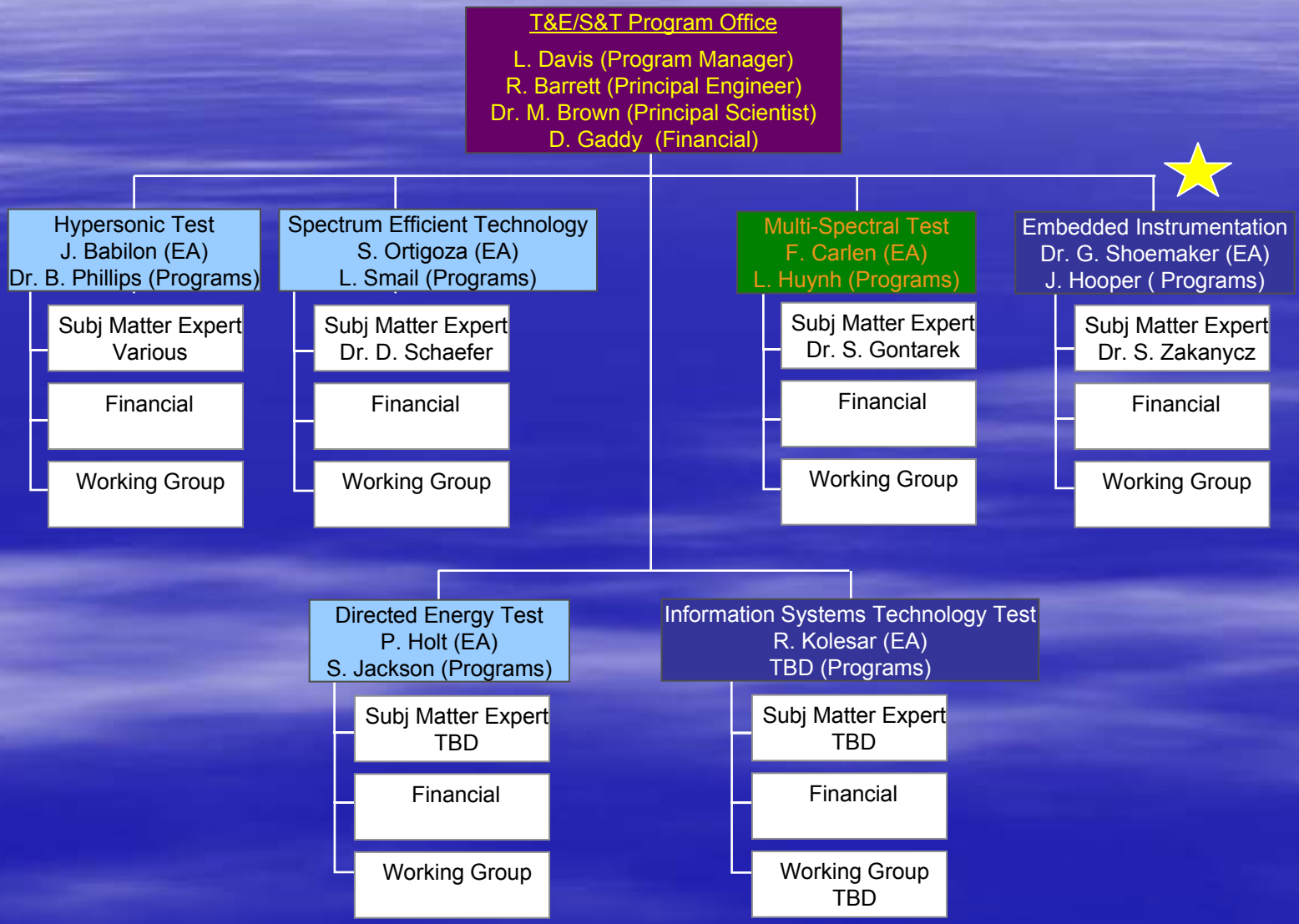


Test technology keeping pace with the future

T&E/S&T Program

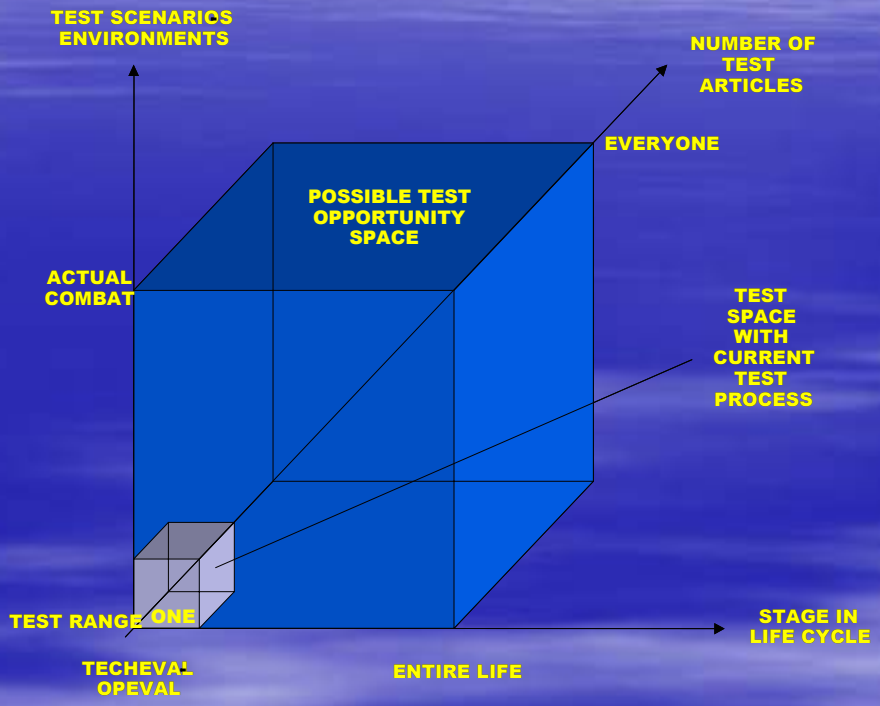
- Leverages successful applied research and ongoing advanced technology development by transitioning S&T efforts from labs, academia, and industry to T&E capability developers and users
- Funds test technologies that keep pace with evolving weapons technology
- Ensures that we have the technology to adequately test future advanced systems

T&E/S&T Program Organization



T&E Vision for the Future of Embedded Instrumentation

- Test data is now collected for only a limited set of circumstances - *Once*
- EI enables an expansion of the test opportunity space
  - To include all systems produced
  - For the full life of each system
  - From the DT/OT events to every training exercise and combat mission
- EI has the potential to transform the *T&E Process* from single discrete events to a continuous measurement cycle for each warfighting system

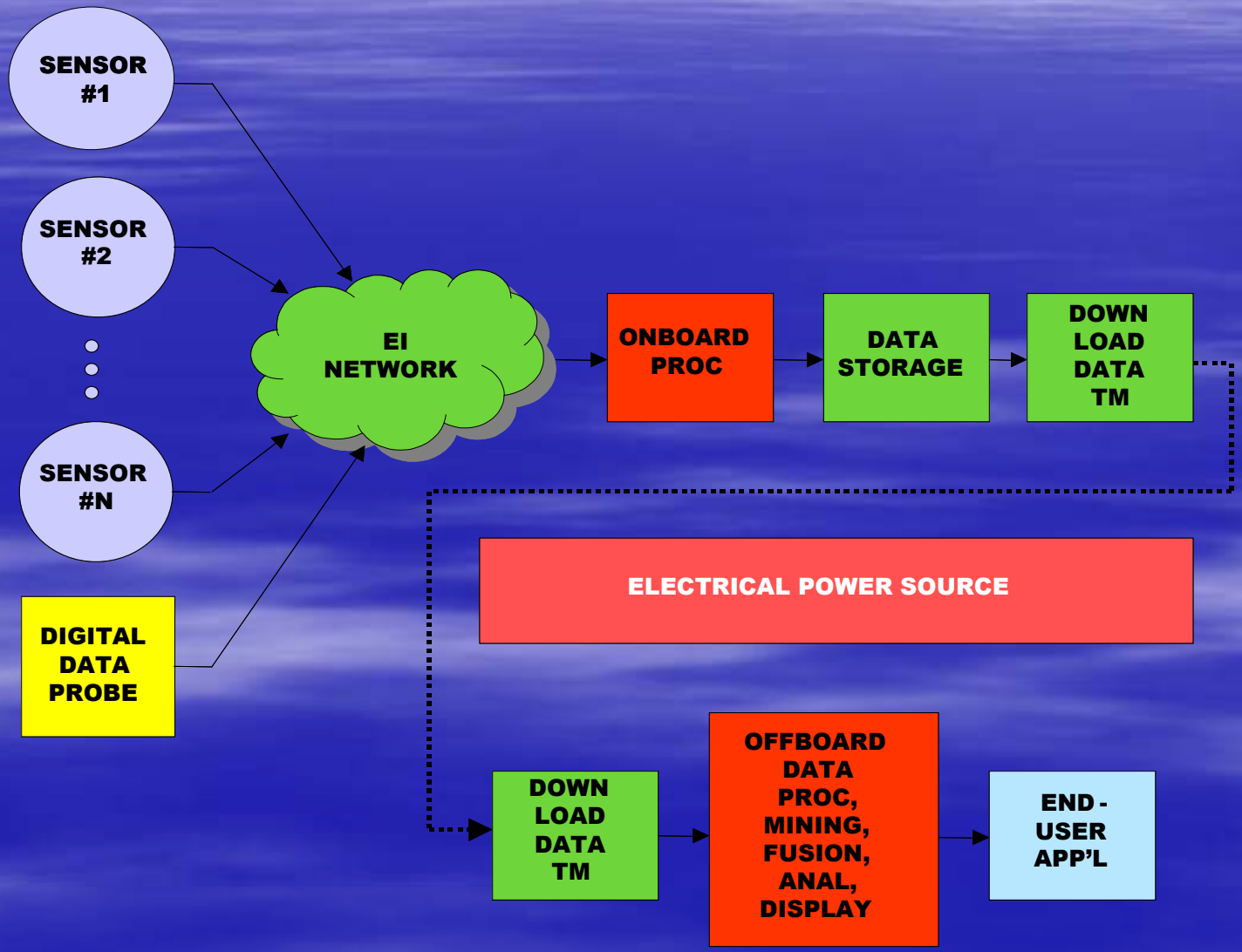


"Technology Enabled T&E Process Transformation"

Embedded Instrumentation System

An Embedded Instrumentation System (EIS) is an integrated suite of specialized components that provides information about a host system to a person or process who evaluates the information to make technical and/or programmatic decisions about the present and/or future design of the host system. The systems of concern include the warfighting system itself as well as all necessary supporting systems such as but not limited to test and evaluation, training and logistics support systems and may be a standalone systems, a subsystem thereof, or a system of such systems. It is characterized as performing its functions as an integrated part of the host system installed therein as part of the original system design or added separately (appliqué) after the basic host system design. The EIS components may be self-powered and are of such size and weight as to not impact the design, fabrication, and/or performance of the host system (non-intrusive). Further, integration is such that its mis-performance or failure does not in any way affect the performance of the host system.

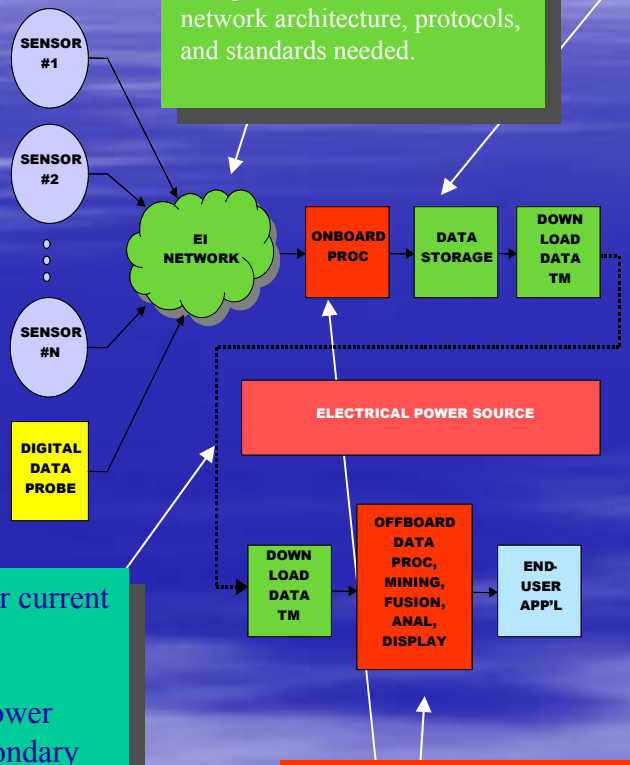
Embedded Instrumentation System



- ***Data Collection***: The gathering of analogue and/or digital data pertaining to the characteristics and/or performance of the host system and its environment. It includes transducers intended to convert any form of energy into electrical energy bearing a known functional relationship to the source energy as well as specialized mounting/installation technologies. Included are software applications intended to mine data from the host system.

- ***Data Transport*** which moves data from the collection device to point in the EIS which may include a processor, storage, and/or telemetry system and includes the physical medium over which the data is transported as well as the network architecture, protocols, and standards needed.

- ***On-Board Data Storage***: Any technology located onboard the host system capable of storing analogue and/or digital data in raw or processed form for purposes of archiving, processing, and/or evaluation at a later time. It includes the storage medium as well as the read/write functionality of the technology.

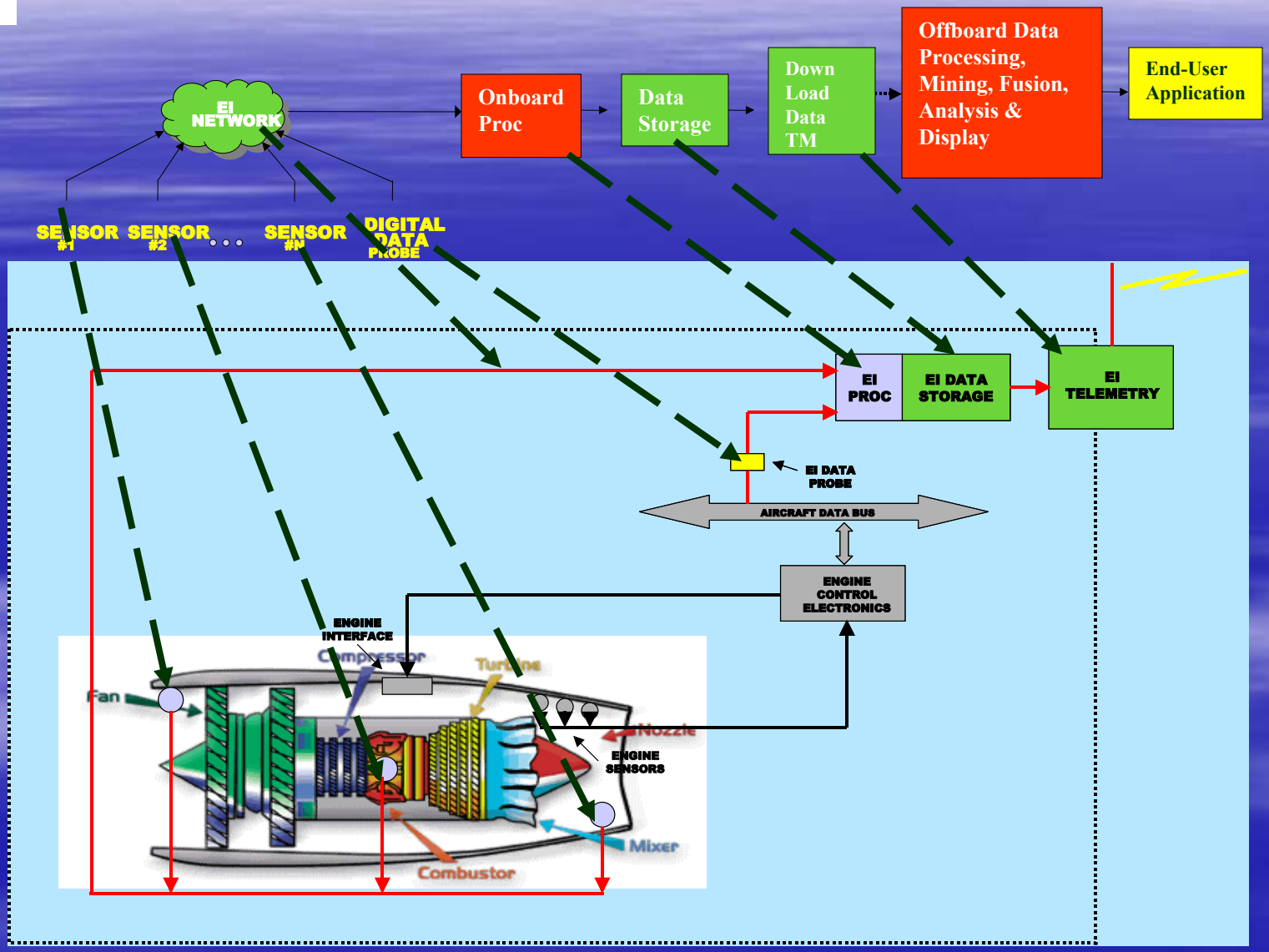


- ***Data Telemetry***: The function of transporting data and/or information off the host system in real-time or post-event to an end user as well as the offboard control of the EIS by the end user. TM is medium independent. The EI Focus includes the development of new technology for the establishment of a conventional TM capability and/or miniaturization and/or hardening of telemetry components as they reside on or in the host system but does not include the development of telemetry media or telemetry protocols and standards.

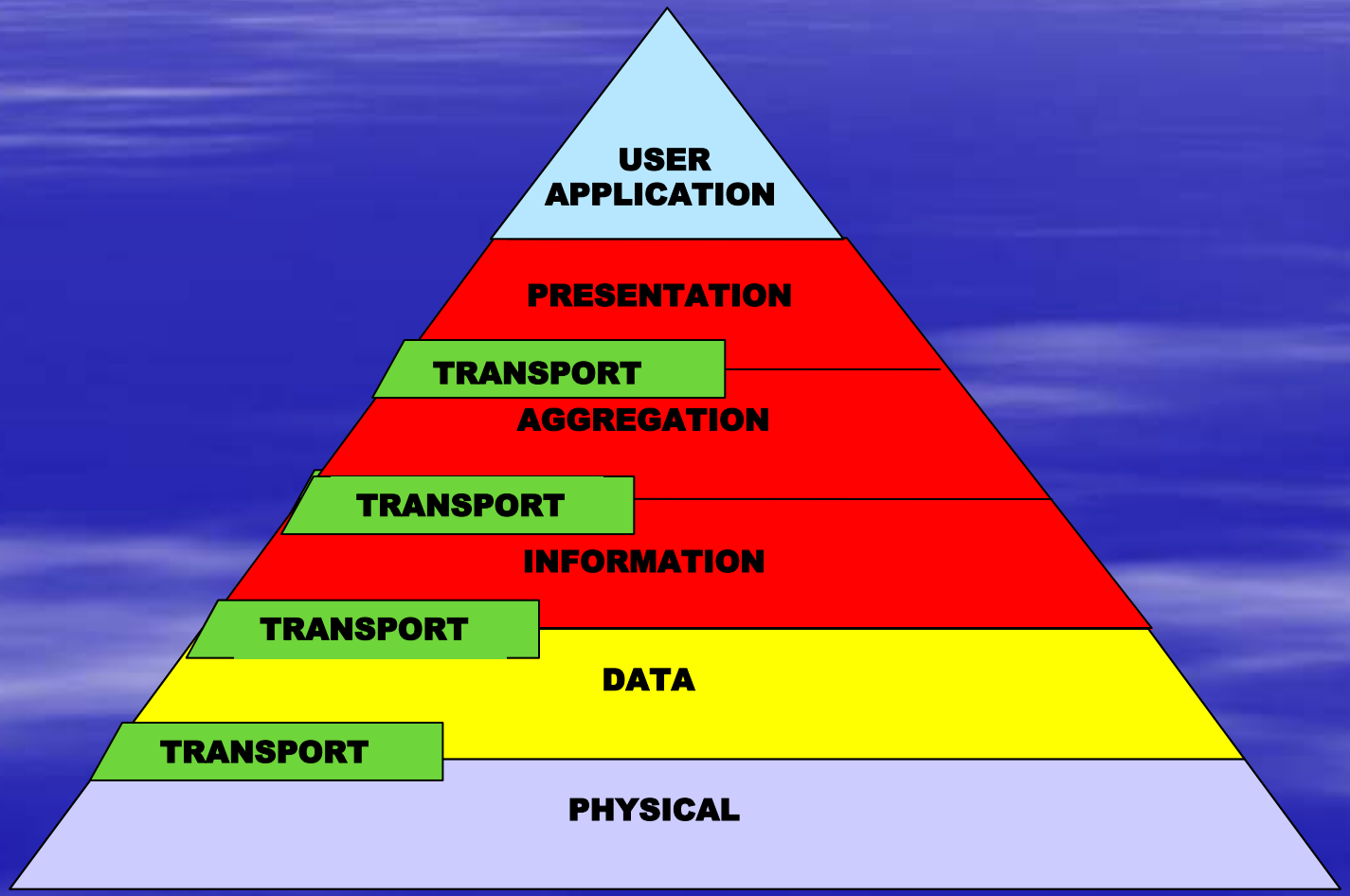
- *Electrical Power*: A voltage and/or current source intended to operate the EIS components and able to operate independently of the host system. Power may be provided as a primary or secondary electrical storage device and/or as a generator. A generator may convert any form of potential or kinetic energy available from the host system or the environment into electrical energy and/or provide for the sympathetic absorption and conversion of electrical power from the host system or any external energy field.

- ***Data Processing***: The application of specialized algorithms implemented in hardware and/or software to prepare the data for transport, storage and/or telemetry as well as processing, analysis, evaluation, and display. It includes but is not limited to data reduction/compression, fusion, and encryption. Processing may take place on or in the host system or offboard the host system.

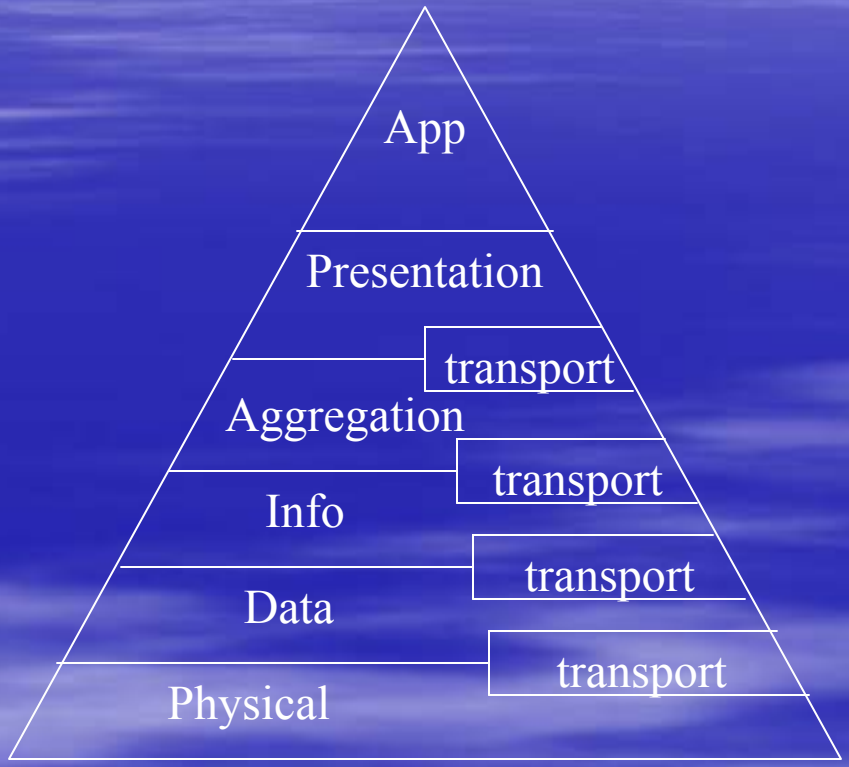
Example EIS Integration



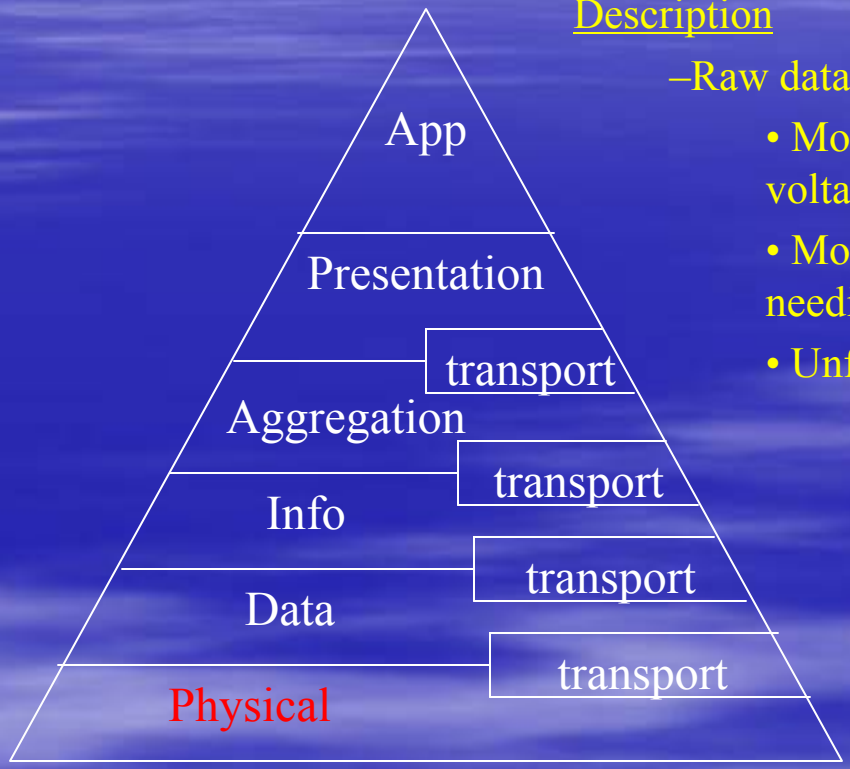
Embedded Instrumentation TRM



Information-Centric TRM



Information-Centric TRM
Physical Layer



Description

–Raw data

- Most likely analog, i.e., voltage or current
- Most likely transitory, needing to be sampled
- Unformatted/Unverified

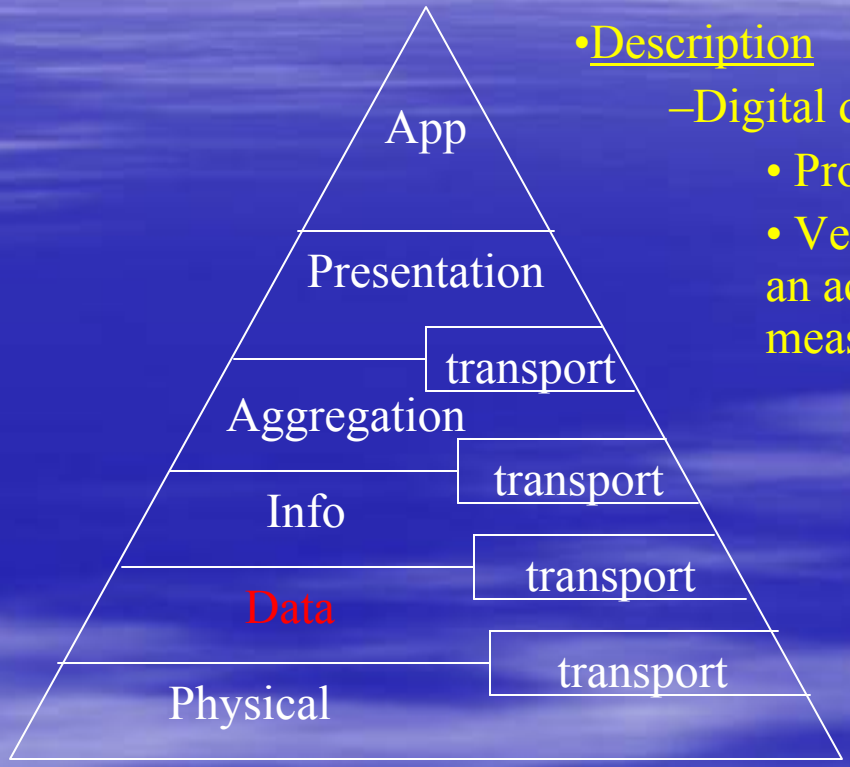
Standards

IEEE 802.xx, EIA/RS-232

Functions

- Functions to collect, interpret and insert data

Information-Centric TRM
Data Layer



•Description
–Digital data
• Probably not scaled
• Verified to represent an accurate physical measurement

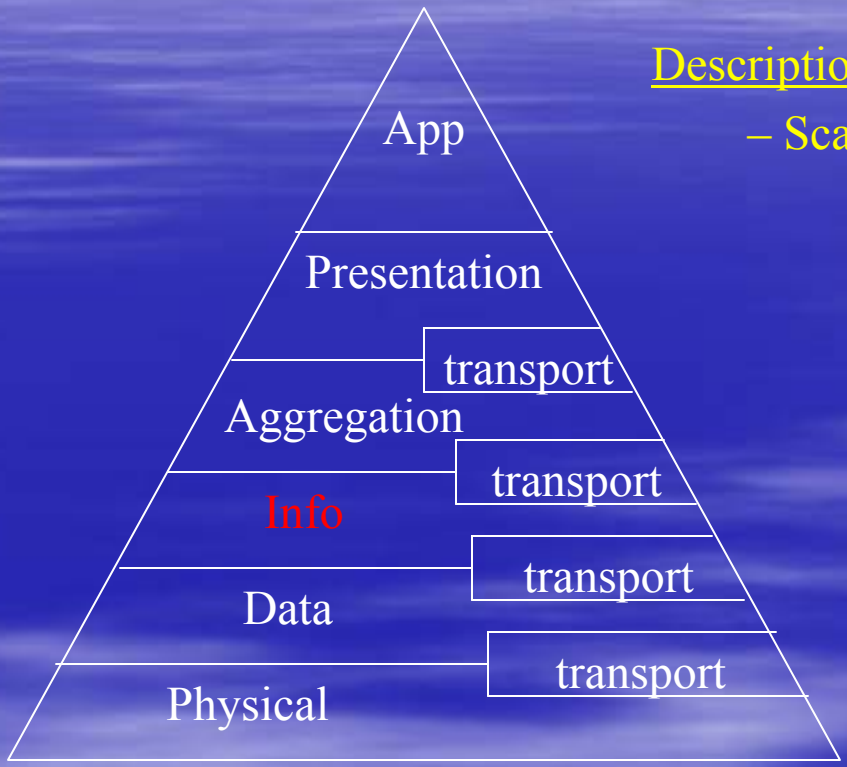
Standards

ASCII

CRC-32

Functions
• Extracts raw data and transforms it to verified digital measurements

Information-Centric TRM
Information Layer



Description

– Scaled data or datums

Standards

SQL

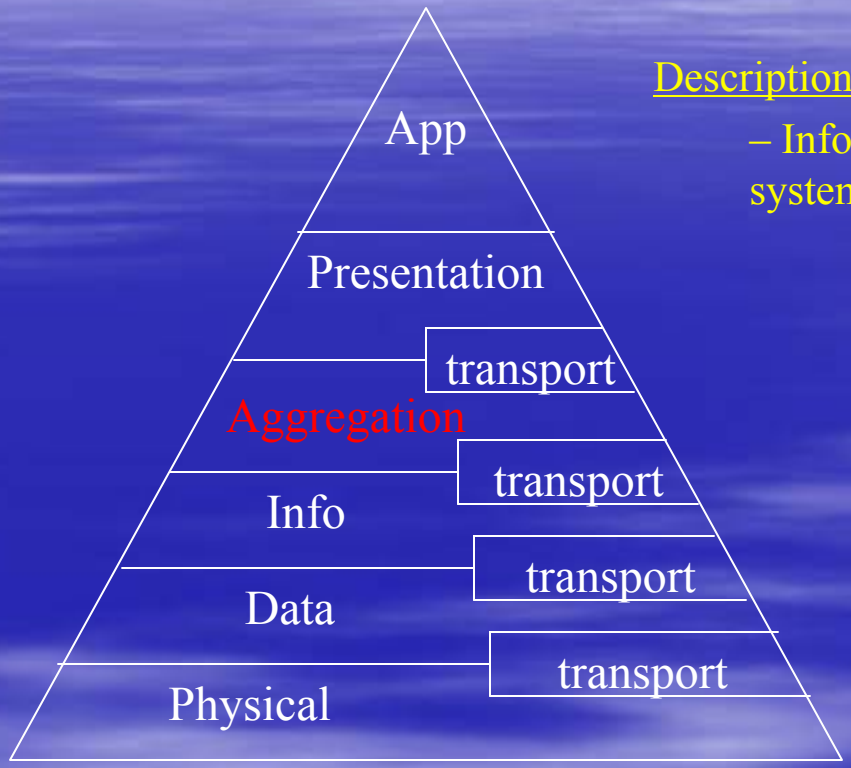
JPEG

RSA

Functions

- Associate structured information items with measured systems elements
- Describe schema for datums into information fragments (system facts)
- Encryption/Decryption

Information-Centric TRM
Aggregation Layer



Description

– Information that is specific to systems or subsystems

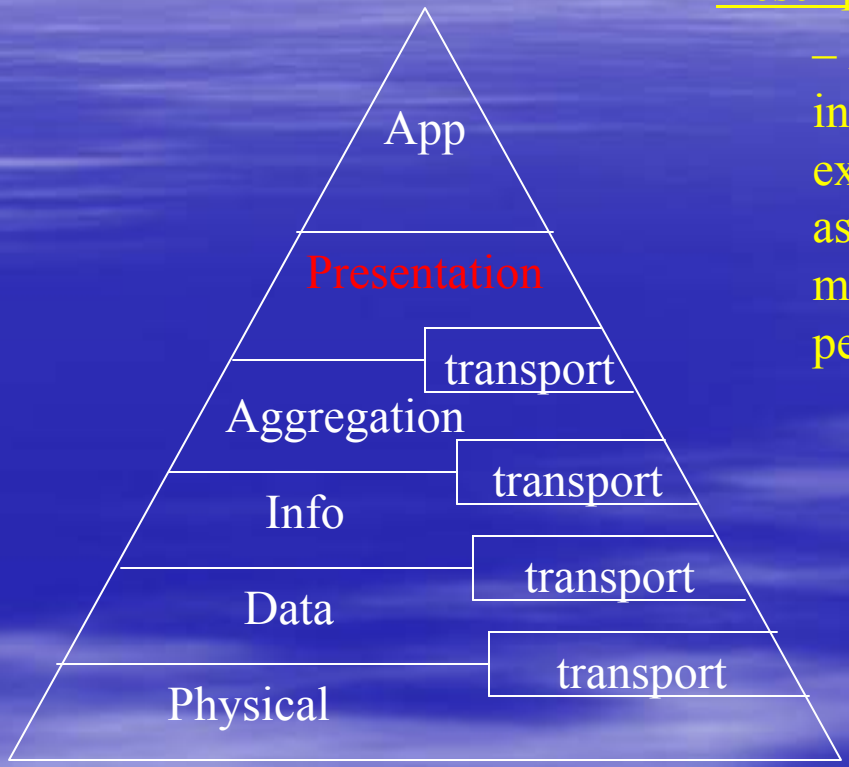
Standards

SQL MM
SQL
Temporal
SQL RT

Functions

- Information from multiple sensors combined to give insight into component/subsystem/system perfor
  - Allow for registering data sources
  - Allow for associating (relating) data sources to form a complex aggregation
  - Allow for spatial / temporal registration of sources (access patterns)

Information-Centric TRM
Presentation Layer



Description

– Aggregation-level information combined with external information, such as red-line parameters, maintenance schedules, performance specs, etc.

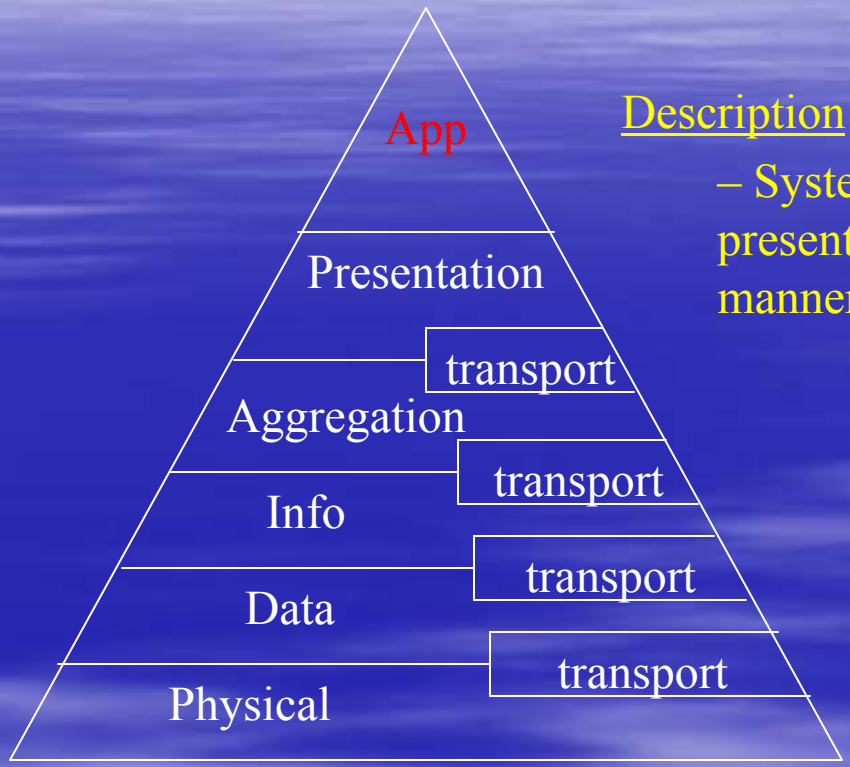
Standards

Data warehouse SQL DM

Functions

- Extract pertinent information
- Compared to expected values
- Format or packaged to display

Information-Centric TRM
Application Layer



Description

– System information presented in a uniform manner

Standards

TBD

Functions

-- Programs to use the information

Real time display

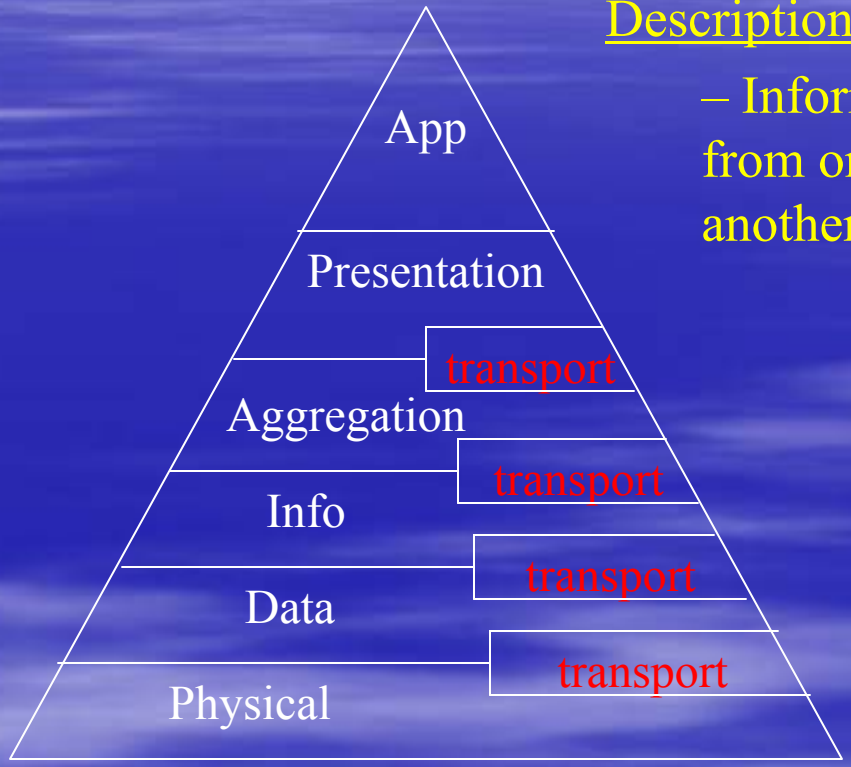
Field level maintenance

Depot level maintenance

Data warehousing, trend analysis, etc

Extract information for modifications and follow-

Information-Centric TRM
Transport Layer



Standards

TCP

HTTP

Range telemetry

EIA/RS-232

IEEE 802.xx

Description

– Information is moved from one system to another system

Functions

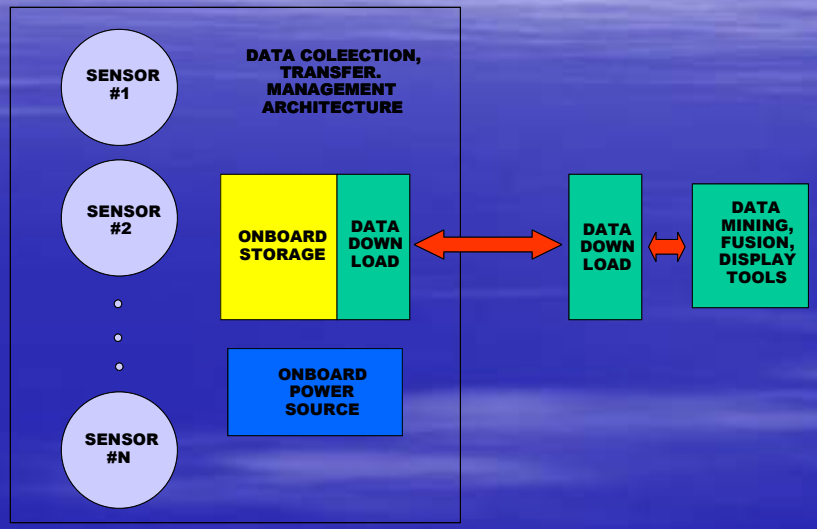
- Format or packaged information to transmit

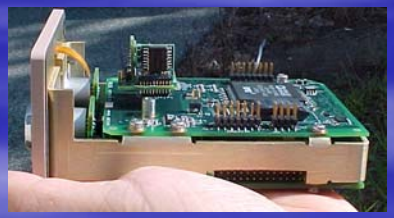
EI Enabling Technologies

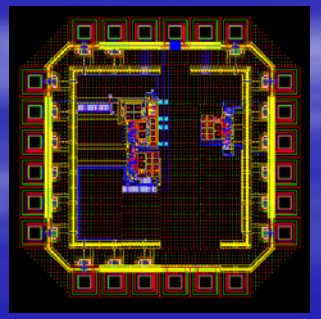
- Instrumentation suites that are miniaturized and light-weight, with increased survivability and non-obtrusive installation
- Improved sensor sensitivities
- Onboard power sources
- Plug-and-play, open architecture to support the full gamut of applications and users (development, test and evaluation, training, logistics and employment effects)
- Reconfigurable, self-healing networks
- Miniaturized telemetry components
- Advanced massive storage, data mining and processing tools

Embedded Instrumentation Focus

- Smart Sensors
- Massive Data Storage
- Reconfigurable, self-healing networks
- Onboard power sources
- Miniaturized telemetry components
- Advanced data conditioning and processing tools







Embedded Instrumentation Vision

- *Develop and demonstrate non-intrusive embedded instrumentation sensors, power sources, data storage technologies and architecture concepts that enhance T&E of warfighting systems, reduce the cost of data collection and improve interoperability and standardization on ranges. Specific objectives include:*
  - *Sensing and collecting critical test performance data*
  - *Enhancing data storage and transmission*
  - *Determining high accuracy and continuous time, space, position, and attitude information*
  - *Interfacing with command and control data links*
  - *Monitoring and reporting all communications and their responses*
  - *Reporting human operator performance*

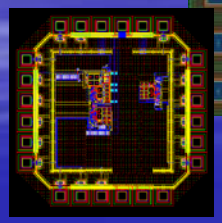
EI Challenges and Approach

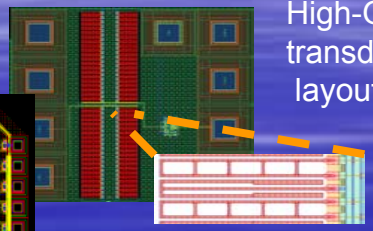
- *Challenge: Instrumentation requirements for future systems-under-test and hardware-in-the-loop testing are increasing exponentially. Early involvement of Test and Evaluation in the acquisition cycle is essential.*
- *Approach: Develop enabling technologies for miniaturized non-intrusive instrumentation suites that demonstrate increased survivability.*
  - *improved sensitivity sensors*
  - *new demonstrations in alternative and micro-power generation to power test instrumentation*
  - *increased embedded data processing capacity*
  - *both plug-and-play and open architectures to support multiple applications and users (development, test and evaluation, training, logistics and operational employment).*

Embedded Instrumentation Technology Overview

Micro-Sensors

AMFTI

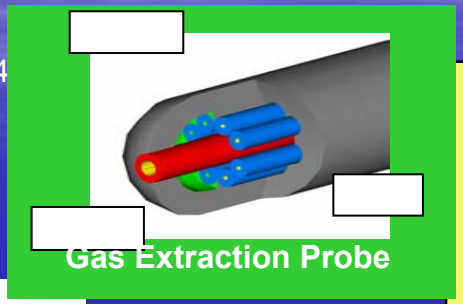




High-G X transducer layout, Jan 04

Circuit layout, Jan 04

GT PROBE

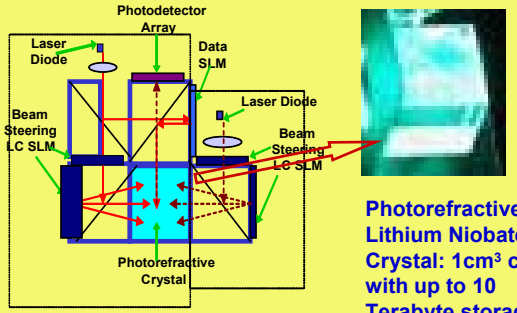


Gas Extraction Probe

Advanced Data Storage

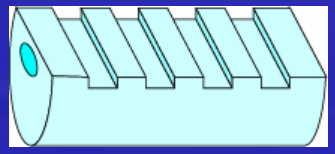
HOLO CUBE

Compact High density, High data Rate Holographic Memory

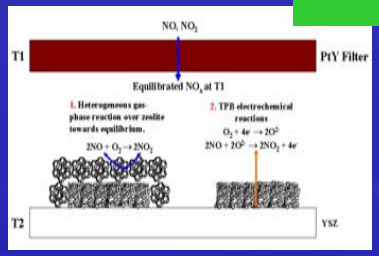


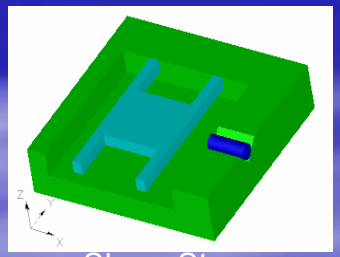
Photorefractive Lithium Niobate Crystal: 1cm³ cube with up to 10 Terabyte storage capacity

D FIBER



CO MEMS

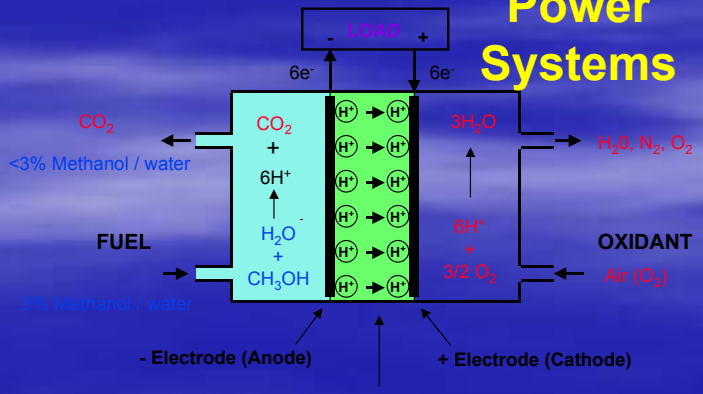




Shear Stress

MEMS FO

Power Systems



DMFC

Advanced Combat Systems

Embedded Instrumentation…T&E for the Future

FY 2005	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY 2013	FY2014

Define EI → Develop Architecture → Develop EIS → EI is Part Of a System

Deploy Architecture → Deploy Appliqué → System of Systems

High Density Storage

Metadata Standards

MEMS IMU

Instrumentation Data Bus

System Interface

Micro Power

Advanced Data Fusion

Common Tools

MEMS Packaging

Chip-Based Telemetry

Virtual Sensors

Everyone Benefits

- System Acquisition Manager - lower test cost/development risk, enhanced spiral development/APB/P3I process
- Tester - Continuous testing throughout the lifetime of the system in multiple operational environment
- Trainer - Operator and maintenance training through monitoring personnel and system performance
- Tactician - Hard, quantitative continuous system performance data to support better system employment
- Warfighter - Full understanding of warfighting system capabilities and vulnerabilities, better trained personnel, tactics validated by data, enhanced reliability, maintainability and availability (RMA) and reduced logistics

Challenges

- Process change can be uncomfortable
- Embedded Instrumentation requires data collection requirements and components to be integral to the warfighting system design (cultural change)
- Need for new technologies
- Non-intrusiveness
  - Minimal size
  - Extremely low weight
  - Low power
  - Affordable cost

T&E/S&T Program Roadmap

T&E/S&T Focus Area and Goals	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009

FOCUS AREA: EMBEDDED INSTRUMENTATION (EI)

Technology for continuous and non-obtrusive T&E

- Miniaturization and reduced-weight sensors and instrumentation packaging
- Reductions in on-board power demands
- Instrumentation command and control
- Advanced algorithms

- Direct Methanol Fuel Cell for Armored Vehicle Instrumentation
- EI Study
- Compact Holographic Data Storage
- Carbon Monoxide Emissions Sensor for Gas Turbine Engines
- Advanced Munitions Flight Test Instrumentation
- D-Fiber Optic Sensor
- MEMS Fiber Optic Sensors
- Gas Turbine Engine Probe
- Distributed EI architectures for T&E applications
- Data bus concepts for platform integration
- Synthetic instrumentation
- Miniaturized reduced weight sensor instrumentation packaging
- Harsh environment survivable instrumentation
- Wireless data and communications transfers and distribution
- Vehicle power lines as a data bus
- Low power instrumentation
- Compact high capacity data recorders
- Techniques for applying metadata
- Passive ground truth instrumentation
- Human performance instrumentation
- Anti-jam processing techniques for EI
- Non-intrusive network interfaces
- Command and control instrumentation
- Telemetry on-a-chip
- Tunable MEMS transceiver
- Electro-adhesives
- Advanced data fusion algorithms

FY05 EI BAA

- Issued by NUWCDIVNPT on 23 September 2004
- Open to government, industry, and academia (teaming highly encouraged)
- Seeks innovative, high risk/high payoff state-of-the-art technologies for EI system architecture
- Proposals due November 5, 2004 (25 pages maximum)
- Awards in December 2004 timeframe

What You Can Do?

- Understand the impact of robust, mature S&T technology on the advancement of Embedded Instrumentation in support of Test and Evaluation

- Creatively respond to the EI Architecture BAA
  - **Must address a relevant T&E need**
  - **Must be 6.3 S&T effort**
  - **Potential for joint Service application preferred**
  - **Clear transition path for T&E usage**

- **Contact Information:**

-Dr. George Shoemaker, EI Executing Agent, NUWCDIVNPT, (401) 832-5304, shoemakergt@npt.nuwc.navy.mil

Summary

- Embedded Instrumentation holds the promise of Operational Testing throughout the life of the warfighting system
  - Large numbers of SUTs
  - Wide variety of environments
  - Maximum realism
- EI will enhance the acquisition process and provide data for all warfighting system stakeholders

- Questions???

Embedded Instrumentation (EI) BAA Bidders Conference
October 6, 2004
Sheraton Airport Hotel
Warwick, RI

The EI Bidder's Conference opened on 6 October 2004 at 1:00 in the Newport South room of the Sheraton Airport Hotel in Warwick, Rhode Island. The purpose of the meeting was to review the EI program and answer any questions concerning the EI BAA.

Introduction: Lisa Brazil opened the conference with instructions to all participants about the meeting protocol. This purpose of the conference was to answer questions about the technical portion of the EI BAA.

All proposals are due on Tuesday, 5 November 2004 at 14:00 and should be sent to the attention of Maria Goulart, Code 59, building 11. The meeting attendees list and questions and answers will be posted on the NUWC website approximately 1 ½ weeks after the Bidder's Conference.

Dr. George Shoemaker continued the conference with a power point briefing of the EI program. Questions and answers follow.

Questions and Answers:

Location	Questions	Answers
	If the possible implementation is more applicable to a particular element (soldier, etc.) which is of greater interest to one or two services, is that of interest?	Yes
	As this is NUWC running a DOD program, is there an equal cross service interest or are Navy-NUWC projects of greater interest?	No, Navy NUWC projects are not of greater interest than any other service.
	Can you identify the individuals on your Executing Agents team?	No. You need to verify that any government individual you partner with is not a working group member.
	Can you provide the POC information on the other focus areas, other than EI?	E-mail Dr. Shoemaker and he will reply.
	What is the relation of this topical BAA to the general BAA that is current until June 2005?	None. However if you have submitted a proposal under the current general BAA and it is applicable to the EI BAA, the proposal should be resubmitted under the

		EI BAA.
	How should we organize our response, by platform type or technology area?	In accordance with the outline in the BAA.
	What is the transition path?	The proposer must identify this.
	What is the requirement for the size of the company?	There are no predetermined limits.
	Does this require hardware or could it be a software solution?	The software solution is acceptable, but it must demonstrate the EI concept.
	How about a prototype that has been developed for phase I or II through SBIR?	That's alright as long as the proposed effort is new work and applicable to this BAA.
	Do we need past experience with the DOD as a company?	No.
	Does the working group have a particular application that is favored for the transition phase?	No.
	Is it better to approach the BAA with a focused application rather than a technology with broad uses?	Neither one is preferred to the other.
	Are there any small business requirements.	If your proposal meets the criteria of FAR 19.702, a small business subcontracting plan must be submitted.
	If the technology applies to more than one topic, eg. air & space systems and armaments and munitions, should a proposal be submitted under each topic.	If the proposal fits multiple areas, submit a proposal identifying all areas. You might indicate applicability to multiple areas in the Executive Summary.
	Are there a preferred set of formats for transferring data?	No.
	Is compression of interest for storage of data?	Yes
	Do they expect telemetry data to be encrypted for transmission?	Perhaps
	Paragraph A2 in the announcement strongly encourages consideration of previous work, but Paragraph B2 states that the	The government is not interested in funding enhancements to proprietary products.

	government is not interested in funding enhancements to products that exist. Please clarify this apparent conflict.	
	Are small businesses given any preference in the selection process	No.
	Where does RF telemetry fit that is not part of spectrum?	It may be of interest here.
	Because of the short period of time before submittal, how quickly will the attendees list be posted?	It will be posted as part of the amendment with answers to questions..
	Please restate the web page referenced earlier in presentation.	http://www.npt.nuwc.navy.mil/contract/
	In the land combat systems section 3, the BAA mentions "minimal" power and weight. Are those specific requirements or constraints? Can you further quality the term "minimal"?	There is no specific requirement.
	Is an interface mandatory to all networks?	No.
	Will you support a partial solution? For example, a key sensor that is needed but does not include other elements for a complete T&E.	Yes.
	Regarding land combat systems, are there any physical size constraints? The section on air & space systems does specify 1 cubic inch.	No.
	Is there an alternate method of submitting proposals electronically?	Three hard copies plus a CD Rom must be submitted as stated in the BAA.
	Can classified work be proposed?	Yes, but follow the appropriate procedures.
	What is a website for defining 6.1, 6.2, 6.3, etc. What is 6.3?	While most agencies break out R&D into the three categories of basic research, applied research, and development, DOD divides its RDT&E (Research,

		Development, Test, and Evaluation) account into seven categories, each with a numerical code: Basic Research (known as "6.1"), Applied Research ("6.2"), Advanced Technology Development ("6.3"), Demonstration and Validation ("6.4"), Engineering and Manufacturing Development ("6.5"), Management Support ("6.6"), and Operational Systems Development ("6.7"). DOD also funds some R&D and support costs in non-RDT&E accounts, and funds applied research on medical topics in the Defense Health Program. Please see the following for more detailed information: http://www.aaas.org/spp/rd/dod05p.htm
	What is the range of funding for previous similar projects?	Funding is dependent upon project scope, labor and time. The program has funded short duration (6 month) projects as well as multi-year efforts. Funding in any given year has ranged from $100K to $500K per project.
	What exactly are some of these projects/ programs, eg. Satellites, under surface, water sensors, etc.?	It is not appropriate to review projects that are currently active in the program.
	Would an existing T&E sensor system (currently used for military R&D) be favored over a "new" sensing system? In other words, can the BAA be used to break down barriers to wider practical use through a: 1. miniaturization step 2. integration of "layers" 3. increased processing power (locally, ie. At sensor) 4. maintenance free (ie, no battery replacement) 5. self test/self cal	Not necessarily. Existing sensor systems are not necessarily favored over "new" designs. However, the numbered items in the question may be of interest even if applied to existing systems.
	The BAA states 1 year to	The program has funded projects from six

	prototype. This limits the scope of the development.	months to three years. The point of the statement in the BAA is that there must be a measurable, deliverable product for each year of funded effort.
	The BAA states that the government is not interested in funding enhancements to proprietary products, but is interested in COTS. Please define the boundary between the two.	The government is interested in S&T technology transition to support T&E. For example, COTS may provide an attractive, viable, cost-effective solution to a T&E requirement, if it is repackaged to support military weapons testing.
	You mention leveraging programs "underway". Can you explain in more in depth?	The government is interested in leveraging embedded instrumentation or S&T work that may be funded by other organizations, such as, DARPA, for example.
	Can you define Architecture? Are you referring to the backbone of the system?	**open systems architecture: 1.** The layered hierarchical structure, configuration, or model of a "system" that (a) enables system description, design, development, installation, operation, improvement, and maintenance to be performed at a given layer or layers in the hierarchical structure, (b) allows each layer to provide a set of accessible functions that can be controlled and used by the functions in the layer above it, (c) enables each layer to be implemented without affecting the implementation of other layers, and (d) allows the alteration of system performance by the modification of one or more layers without altering the existing equipment, procedures, and protocols at the remaining layers. Layers should be designed to use open systems standards. *Note 1:* Examples of independent alterations include (a) converting from wire to optical fibers at a physical layer in the 7 layer ISO network architecture model without affecting the data-link layer or the network layer except to provide more traffic capacity, and (b) altering the operational protocols at the network level without altering the physical layer. *Note 2:* Open systems

		architecture may be implemented using the OSI Reference Model as a guide while designing the system to meet performance requirements.
	For down loading data via TM, what is the range?	It varies, but could reasonably be viewed as line-of-sight.
	What is more important, proposing a sensor, a network, the architecture, or the complete solution?	One element is no more important than another.
	The sensors listed on the Navy Sea application appear to be more tactical sensors than performance sensors	The government is seeking embedded instrumentation to support weapons and platform testing.
	Does everything have to be in place when the proposal is submitted?	Your proposal should follow the outline in the BAA.
	Your opening slide listed a number of universities that apparently had been involved in the program. Would it be possible for you to provide a point of contact for those universities such as Ohio State, University of Cincinnati, etc? I met the Brigham Young attendee, but that was only one of the universities on your opening slide.	No.

PRE-PROPOSAL CONFERENCE SIGN-UP SHEET
EMBEDDED INSTRUMENTATION FOR TEST AND EVALUATION
BAA #043338

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